REMARKS

Summary

This Amendment is responsive to the final Office Action mailed on November 18, 2003. Claims 1 and 15 are amended herein. Claims 1-13, 15-27, and 29-32 are pending.

Claims 1-2, 7-13, 15-16, and 21-27, and 29-32 stand rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Henley (US 5,459,410) in view of Kurogane (US 6,259,424) and Hiroki (US 6,618,115).

Claims 3-4, 17-18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Henley, Kurogane, and Hiroki in view of Yamakazi (US 6,147,667).

Claims 5 and 19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Henley, Kurogane, and Hiroki in view of Yang (US 6,392,427).

Claims 6 and 20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Henley Kurogane, and Hiroki in view of Anholm (US 5,043,655).

Applicants respectfully traverse the foregoing rejections in view of the amended claims and the following comments.

Discussion of Amended Claims

Claims 1 and 15 are amended to clarify that the liquid crystal micro-display is built on a silicon integrated circuit substrate, said substrate having an integral complimentary metal-oxide semiconductor (CMOS) control chip containing CMOS drive circuitry.

Discussion of Henley

Henley discloses a method for repairing inoperative pixels

by providing redundant TFT drive circuitry for each pixel (Col. 12, lines 13-41).

In contrast, the present invention relates to repair of defective pixels having CMOS drive circuitry. With the present invention, logical repair of the defective pixel is accomplished while avoiding the overhead of a redundant drive circuit as used by Henley. Applicants' invention accomplishes the repair of the defective pixel by connecting an inoperative pixel to the working drive circuitry of a nearby pixel, avoiding the need for redundant drive circuitry as disclosed in Henley.

The Examiner has acknowledged that Henley does not disclose repairing a defective pixel by connecting an inoperative pixel to the working drive circuitry of a nearby pixel, as set forth in Applicants' claims (Office Action, page 2). Further, the Examiner has acknowledged that Henley does not show a display having CMOS drive circuitry, as claimed by Applicants (Office Action, page 3).

Discussion of Kurogane

The Examiner indicates that Kurogane discloses connecting the driver of one pixel to fix a defect in another pixel (Office Action, page 2). Kurogane discloses a process for building an LCD display using TFT technology. In Kurogane, a defective transistor 1A is not electrically connected to the pixel electrode 2A, and the pixel electrode 2A of the defective pixel 21 A is electrically connected to the pixel electrode of the adjacent normal pixel 22B (Col. 9, lines 57-64; Figure 7).

The disclosure of Kurogane is limited to connecting the defective pixel to the drive of an immediately adjacent pixel. In contrast, the present invention is not limited to immediately adjacent pixels. The methods and apparatus of the present invention are suitable for connecting the repaired pixel to other

pixel drives besides that of immediately adjacent pixels. With Applicants' claimed invention, the inoperative pixel is connected to the working drive circuitry of a nearby pixel. As set forth in Applicants' claims, a nearby pixel may comprise an adjacent pixel or a non-adjacent pixel. Such a repair strategy is not available in the TFT LCD displays of Kurogane, since there is limited room for routing connections in the LCD layers. The use of CMOS technology provides greater flexibility for connections between layers, thus enabling the repair to be accomplished between non-adjacent pixels as well as adjacent pixels, rather than only adjacent pixels as disclosed in Kurogane.

Kurogane does not disclose or remotely suggest methods that are suitable for connecting working drive circuitry to non-adjacent inoperative pixels, as claimed by Applicants.

The technology disclosed in Kurogane is limited to the field of LCD displays built using TFT technology. Applicants' claims are directed towards repairing defective pixels having defective CMOS drive circuitry. The Examiner has acknowledged that Kurogane does not disclose CMOS drive circuitry as claimed by Applicants (Office Action, page 4).

Further, the Examiner has acknowledged that Kurogane does not disclose identifying and repairing CMOS drive circuitry for an inoperative pixel after fabrication of the CMOS control chip, as claimed by Applicants.

Discussion of Hiroki

The Examiner indicates that Hiroki discloses a method of identifying and repairing CMOS drive circuitry for an inoperative pixel after fabrication of the CMOS control chip.

Applicants respectfully submit that Hiroki does not use the term "CMOS" to describe a liquid crystal micro-display built on a silicon integrated circuit substrate and having an integral CMOS

control chip as claimed by Applicants. In Hiroki, the term CMOS is used to describe digital logic portions of the display built outside of the pixel area: "Note that for the simplicity of the explanation, a CMOS circuit which is a base circuit for a shift register circuit, a buffer circuit, D/A converter circuit etc. is shown in the Figure for the driver circuit, and an n-channel TFT is shown." (Hiroki, Col. 10, lines 4-8).

Applicants' claims 1 and 15 are amended to clarify that the liquid crystal micro-display is built on a silicon integrated circuit substrate having an integral CMOS control chip.

In contrast to Applicants' design, Hiroki is dedicated to the repair of TFT LCD displays built on a glass or quartz substrate (i.e., similar to the design of Kurogane) (Col. 9, line 65 through Col. 10, lines 11). The CMOS circuitry described in Hiroki is located outside of the pixel area of the TFT LCD display and is therefore not integral to the substrate on which the TFT LCD display is built. Like Kurogane, Hiroki discloses only the use of TFT drive circuitry for the pixels (Col. 9, line 67 through Col. 10, line 1), not CMOS drive circuitry as claimed by Applicants.

Therefore, Hiroki does not disclose or remotely suggest the repair of inoperative pixels in a liquid crystal micro-display which is built on a silicon integrated circuit substrate having an integral CMOS control chip containing CMOS drive circuitry, as claimed by Applicants.

Further, Hiroki does not teach connecting an inoperative pixel to a working drive circuit of a nearby pixel after manufacture of the display, as claimed by Applicants. Rather, Hiroki teaches mitigation of the appearance of the defective pixel by changing the values displayed on neighboring pixels to be brighter, thereby hiding a darker defective pixel. In Hiroki, if the defective pixel appears as a bright dot, its drive is severed such that it appears as a dark dot (Col. 6, lines 16-27).

The appearance of the defective bright pixel which has been turned into a dark dot will then be compensated for by adjusting the brightness of neighboring pixels (Col. 2, lines 28-30).

With Applicants' claimed technique, the effect of defective drive circuitry is mitigated by tying the resultant inoperative pixel to the drive circuit of a nearby pixel, thereby forcing the inoperative pixel to the same value as the nearby pixel. In contrast, the technique of Hiroki mitigates the effect of a defective pixel or its drive circuitry by forcing the pixel to appear as a dark dot and increasing the brightness of neighboring pixels so that the dark dot created by the defective pixel becomes less noticeable.

Therefore, Hiroki does not disclose or remotely suggest that defective drive circuitry of a pixel is disconnected such that the inoperative pixel may be connected to working drive circuitry of a nearby pixel, as claimed by Applicant.

Contrary to Applicants' claimed invention, Hiroki merely compensates for the defective pixel by changing the brightness of nearby pixels. The method of compensating for defective pixels by changing the brightness of neighboring pixels disclosed in Hiroki is easily accomplished after fabrication of the control circuitry. However, Hiroki does not provide any disclosure or suggestion of connecting the defective pixel to a working drive circuit of a nearby pixel after fabrication of the control circuitry, as claimed by Applicants.

The examiner has indicated that it would have been obvious to combine the disclosure of Henley with that of Kurogane and Hiroki to arrive at the claimed invention. However, Applicants respectfully submit that a straight-forward combination of these technologies would not have been obvious to one skilled in the art at the time of Applicants' invention. Kurogane is limited to the repair of an immediately adjacent pixel. Henley accomplishes the pixel repair using redundant circuitry. Hiroki is limited to

compensating for the appearance of a defective pixel by adjusting the brightness of neighboring pixels, without providing working drive circuitry for the defective pixel itself.

To combine Henley and Kurogane to arrive at the present invention would require that the disadvantages of using redundant circuitry of Henley be removed, in addition to overcoming the preliminary detection and repair process required by Kurogane. Neither reference teaches how to overcome these issues. Further, one skilled in the art would not be motivated to look to combine the teachings of Hiroki with that of Henley and/or Kurogane, since Hiroki teaches only compensation for a defective pixel by changing the brightness level of surrounding pixels, and does not provide working drive circuitry for the defective pixel. The combination of Kurogane, Henley and Hiroki taken as described (and in the absence of the teachings of the present invention) is insufficient to result in the functionality embodied by the present invention without further creative thought.

Only with hindsight gained impermissibly from Applicants' disclosure could one of ordinary skill in the art have arrived at the claimed invention from the combination of Kurogane, Henley and Hiroki. Moreover, there are no detailed teachings in any of these prior art references that would have motivated or enabled one skilled in the art to combine them as suggested by the Examiner.

Further, Applicants respectfully submit that a combination of Henley, Kurogane, and Hiroki would not result in the invention described in Applicants' amended claims. None of the cited references disclose a liquid crystal micro-display that is built on a silicon integrated circuit substrate having an integral CMOS control chip.

Applicants respectfully submit that the present invention would not have been obvious to one skilled in the art in view of the combination of Henley, Kurogane, and Hiroki, or any of the

other prior art of record.

Further remarks regarding the asserted relationship between Applicants' claims and the prior art are not deemed necessary, in view of the amended claims and the above discussion. Applicants' silence as to any of the Examiner's comments is not indicative of an acquiescence to the stated grounds of rejection.

Conclusion

In view of the above, the Examiner is respectfully requested to reconsider this application, allow each of the presently pending claims, and to pass this application on to an early issue. If there are any remaining issues that need to be addressed in order to place this application into condition for allowance, the Examiner is requested to telephone Applicants' undersigned attorney.

Respectfully submitted,

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